SP211E 1111/33111 EXAM 3 1998 NAME: _____ PERIOD __

1.) a. Define: Moment of inertia of a collection of point particles (equation & prose)

b. What is required if a collision is to be elastic ?

c. The momentum of an isolated system is conserved. What does it mean to say that a system is isolated ?

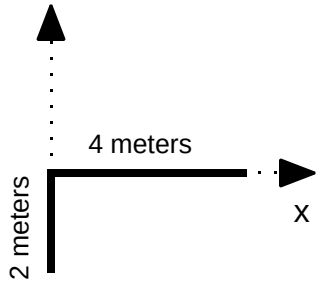
____ (T/F) All parts of a rotating wheel have the same angular acceleration.

____ (T/F) The moment of inertia of a body depends on the location and orientation of the axis of rotation about which the moment is calculated.

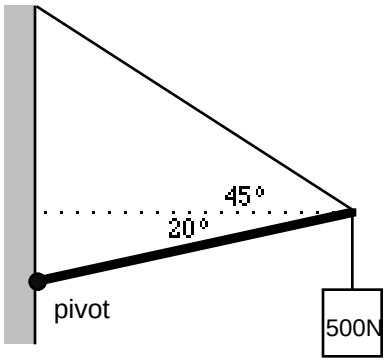
____ (T/F) For a rigid body to be in rotational equilibrium, the net torque exerted on it must vanish **as calculated about any axis**.

2. a.) Find the thrust of a rocket engine that burns 1000 Kg of kerosene and oxygen per second and exhausts the gases at a relative velocity of 2500 m/s.

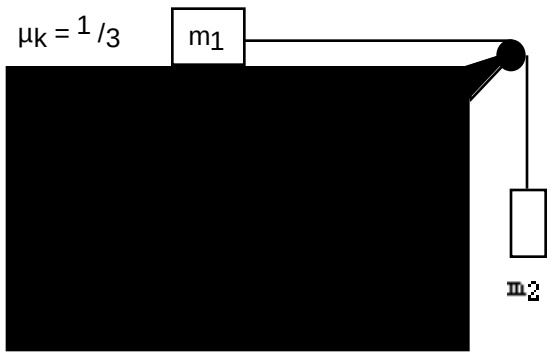
b.) Two straight rods cut from uniform thin rod stock are welded together at right angles as shown to form a rigid object. The 4 meter leg runs along the +x-axis and the 2 meter leg along the -y-axis. Find the location of the CM for the object.



c.) A very light stiff boom is pivoted at the wall and held at 20° above the horizontal by a supporting cable that makes a 45° angle w.r.t. the horizontal. A 500 N load is suspended from the end of the boom. Find the tension in the supporting cable.



3. **Use Work-Energy**: The mass m_1 is initially moving at 1 m/s to the right as it passes a reference point. It is observed as it passes another reference point 2.041 m farther to the right. How fast is it moving as it passes the second reference point ? The coefficient of kinetic friction is one third. The masses are m_1 = 60 kg and m_2 = 40 kg. The pulley is massless and frictionless.



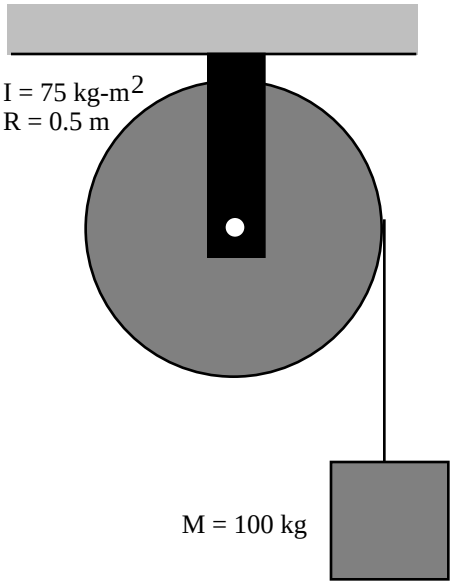
4. A 100 kg mass is suspended from a massive pulley with moment of inertia 75 kg-m^2 and radius 0.5 m. It is found that the angular acceleration of the pulley is -4.9 $^{rad}/_{s^2}$.

a. What must be the tension if the cord to cause that angular acceleration ?

b. What is the constraint relation between α for the pulley and a_y for the hanging mass ?

c. What is the linear acceleration of the 100 kg mass ?

d. At t = 0 s, the pulley is rotating CW at a rate of 4.9 $^{rad}/_{s}$. Find the angular velocity and rotational kinetic energy of the pulley at t = 2 s.



5. **2-D COLLISION**. A ball m_1 of mass 10 kg traveling at 6 $^{m}/_{s}\,\hat{i}$ collides with a ball m_2 of mass 5 kg which is initially at rest. The post-collision velocity of m_1 is $\vec{v}_{1f} = 3\ ^{m}/_{s}\,\hat{i} + 1\ ^{m}/_{s}\,\hat{j}$.

a. Find $\vec{v}_{2f}$. ?

b. Is this an elastic collision ? Explain your response using relevant numerical values that you calculate. !